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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/029,181	10/25/2001	Mark Christiaens	522-1763	4624

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08/12/2004

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EXAMINER

HOANG, PHUONG N

ART UNIT

PAPER NUMBER

2126

DATE MAILED: 08/12/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/029,181	Applicant(s) CHRISTIAENS, MARK	
	Examiner Phuong N. Hoang	Art Unit 2126	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 October 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 - 27 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 - 13, 19 - 20, and 22 - 27 is/are rejected.
- 7) ☒ Claim(s) 14 - 18, and 21 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 October 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>8/4/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Claims 1 - 27 are pending for examination.

Oath/Declaration

2. It does not include the signature of each inventor.

Claim Objections

3. Claim 21 is objected to because of the following informalities:

- a. At line 2, ":" is missing after comprises.
- b. At line 7, "he" is misspelled. It should be "the"

Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claim 27 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

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6. Claim 27 recites a computer-readable programming product but depends from method claim 1. It is unclear if claim 27 is claiming a product or method.

Drawings

7. Figure 15 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawing sheets are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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9. Claims 1 - 2, 4 - 13, and 22 - 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hudson, US patent no. 6,671,707.

10. As to claim 1, Hudson teaches a computer implemented method for classifying objects into a set of global objects, containing objects that can be reached by more than one thread (set of O objects reachable by threads, col. 2 lines 40 - 60, col. 8 lines 9 - 67), and a set of local objects, containing objects that can only be reached by one thread (each object removed from global O objects is only reached by a thread, col. 8 lines 9 - 67 and col. 12 lines 1 - 8), when executing multi-threaded programs, whereby the classifying is done by dynamically (run time, col. 6 lines 57 - 65) modifications to references to objects by operations performed in the computer system (classifying is done in the garbage collection process by removing one or more copies of the global objects pointed to by references, col. 2 lines 40 - 67 and col. 8 lines 9 - 35).

Hudson does not explicitly teach the step of classifying by observing the modifications.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to recognize that the objects have to be observed before selecting and removing the objects to be local objects.

11. As to claim 2, Hudson teaches the step of wherein each object is provided with an instrumentation data structure to enable observation of modifications to references to objects (an object may contain slots, not-slot data,

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or both, col. 2 lines 8 - 19).

12. **As to claim 4**, Huson teaches the step comprising of recording in a memory concurrency state transition information of global objects (the transition of global objects become local object, col. 8 lines 9 - 67, col. 12 lines 1 - 8, and col. 3 lines 64 - 67).

13. **As to claim 5**, Hudson teaches the step of performing garbage collection only on the set of local objects (existing garbage collection account for copied objects, col. 4 lines 14 - 18).

14. **As to claim 6**, Hudson teaches a computer implemented method for detecting inconsistent dynamic concurrency (detect race condition, col. 14 lines 30 - 35) state transitions in the execution of multi-threaded programs amenable to object reachability analysis, the method comprising the steps of:

executing multiple threads on a computer (threads running, col. 5 lines 24 - 45);

at least periodically during execution of the threads (threads running during the garbage collection cycle, col. 5 lines 24 - 45), classifying instantiated objects into a set of global objects that can be reached by more than one thread (set of O objects reachable by threads, col. 2 lines 40 - 60, col. 8 lines 9 - 67), and sets of local objects that can only be reached by one thread (each object

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removed from global O objects is only reached by a thread, col. 8 lines 9 - 67 and col. 12 lines 1 - 8), and

recording in a memory concurrency state transition information of global objects (garbage collection including automatic memory storage management... access, col. 1 lines 60 - col.2 lines 5).

Hudson does not explicitly teach the set of global objects and set of local object containing objects.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to recognize that set of global O objects contain O objects themselves and local objects also contain local objects.

15. **As to claim 7**, Hudson teaches the step of determining occurrence of data races between two or more threads (race condition, col. 10 lines 45 - 50 and col. 14 lines 20 - 35).

16. **As to claims 8 and 9**, Hudson teaches the step of wherein the set of global objects is periodically analyzed so as to remove objects from the global set which are only reachable by one thread (the garbage collection cycles, col. 10 lines 20 - 30, col. 8 lines 9 - 67 and col. 12 lines 1 - 8).

17. **As to claim 10**, Hudson teaches the step of wherein each object created (each copy of O global objects that is reached by a thread to avoid the race condition, col. 8 lines 10 - 30 and col. 10 lines 46 - 55), during execution of the

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program is provided with an instrumentation data structure to enable race detection.

18. **As to claim 11**, Hudson modified by Gallop teaches the step of the data structure comprises:

a first address field for containing the address of a first data structure when the object is locked for the first time (Hudson; lock field, col. 16 lines 1 - 15);

a second address field for containing the address of a second data structure if the object is of type thread or a subtype thereof, a thread identification field (Gallop; thread identifier, col. 15 lines 65 - col. 16 lines 30) for recording whether the object belongs to the global set or to a local set,

a third address field for containing the address of a third data structure when the object belongs to the global set (Hudson; global O object, col. 8 lines 10 - 20).

19. **As to claims 12 and 13**, Hudson modified by Gallop teaches the step of wherein the first data structure comprises a vector clock field for taking into account the fact that threads are created and destroyed dynamically (threads are created and destroyed when locks are acquired or released, col. lock field, col. 16 lines 1 - 15), and indicating the current vector clock for the currently executing event on the thread, and a thread identification number (Gallop; thread identifier, col. 15 lines 65 - col. 16 lines 30).

20. **As to claim 22**, Hudson teaches the step of whereby the method is implemented in virtual machine (Java virtual machine, col. 1 lines 30 – 35).

21. **As to claim 23**, Hudson teaches the step of wherein the method is implemented in an interpreter (interpreter 132, col. 1 lines 45 – 50).

22. **As to claim 24**, Hudson teaches the step of whereby the method is implemented in a compiler (compilers, col. 3 lines 50 – 60).

23. **As to claim 25**, Hudson teaches the step of whereby the method is implemented in hardware (hardware, col. 1 lines 40 – 44).

24. **As to claim 26**, Hudson teaches the step of whereby the method is implemented in a garbage collector (garbage collector, title, abstract).

25. **As to claim 27**, this is the product claim of claim 1. See rejection for claim 1 above.

26. **Claims 3, and 19 - 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hudson, US patent no. 6,671,707 in view of Gallop, US patent no. 6,411,983.**

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27. **As to claim 3**, Hudson teaches the object comprising a data structure, but does not comprises at least a thread identification tag for identifying whether an object can be reached by only one thread or by more than one thread.

Gallop teaches a data structure for comprises at least a thread identification tag (thread identifier, col. 15 lines 65 - col. 16 lines 30) for identifying whether an object can be reached by only one thread or by more than one thread.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teaching of Hudson and Gallop's system because would provide a unique identifier for the owner thread of particular object.

28. **As to claim 19**, Hudson teaches a computer implemented method for determining the order of events (race condition determine the order of memory operations, col. 17 lines 1 - 10 and col. 14 lines 30 - 35) in the presence of a dynamically changing number of threads (changing the number of threads accessing the objects depending whether the object is global or local, col 8 lines 10 - 30) of a computer program on a computer, wherein a clock data structure (determining the Object from root slots, col. 8 lines 5 - 15) is maintained in memory from which clock data structure the occurrence of two events in parallel during execution of the threads can be determined (multiple threads can access the global objects, so the code can be executing in parallel, col. 8 lines 10 - 20).

Hudson does not explicitly teach the step of the dimension of the clock data structure being determined dynamically dependent upon the number of threads created and destroyed during execution of the program.

Gallop teaches the dimension of the clock data structure being determined dynamically dependent upon the number of threads created and destroyed during execution of the program (the data structure having two pointers: lock and unlock, col. 15 lines 65 - col. 16 lines 30).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teaching of Hudson and Gallop's system because Gallop's data structure would provide a field to determine the lock that can detect the data race.

29. **As to claim 20**, Gallop teaches the step of wherein the clock data structure comprises a lock (lock, col. 16 lines 1 - 30) to be taken by a thread if exclusive access to the clock is required, and the address (pointer, col. 16 lines 1 - 30) of a local clock data structure.

Allowable Subject Matter

30. Claims 14 – 18 and 21 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

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Conclusion

31. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phuong N. Hoang whose telephone number is (703) 605-4239. The examiner can normally be reached on Monday - Friday 9:00 am to 5:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng-Ai An can be reached on (703)305-9678. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Ph
August 4, 2004


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